

3

Improvement Concepts

This chapter describes the development and evaluation of a broad range of corridor-length improvement concepts within the I-81 and rail study areas. It is intended to provide decision-makers with a range of options to support an informed decision on how to address the I-81 corridor needs.

The term *improvement concept* is used in this document rather than the traditional term “*alternative*” because the improvements developed for this study are conceptual. These concepts provide the detail commensurate with a Tier 1 NEPA document and the decisions to be made. More details of the specific improvement alternatives would be developed in Tier 2, if one or more of the “Build” concepts are advanced into Tier 2. These details would include information such as lane requirements, auxiliary facilities, and construction details.

Background information about I-81 is presented in Chapter 2, *Purpose and Need*. Background and context for the study of rail is provided in the *I-81 Corridor Improvement Study Transportation Technical Report*, which includes the memorandum issued by FHWA regarding the analysis of rail improvements. Toll diversion information is provided in the *I-81 Corridor Improvement Study Toll Impact Study*. Freight diversion information is provided in the *I-81 Corridor Improvement Study Freight Forecast and Diversion Report*. The *I-81 Corridor Improvement Study Concept Development Technical Report* describes the improvement concept development process in greater detail.

3.1 Improvement Concept Development Process

The corridor needs are the benchmark by which potential concepts were measured. As noted in Chapter 2, *Purpose and Need*, the needs are to address existing and future capacity deficiencies and safety deficiencies.

3.1.1 Development of Concepts

A broad range of reasonable improvement concepts were considered within the guidelines of the Process Streamlining Agreement between FHWA and VDOT (see Appendix A). Some concepts emerged from the Scoping Process, some came from previous studies, and others were developed by the study team. The concepts consider planned roadway improvements at the Tennessee and West Virginia state lines and provide adequate distance for transition.

Scoping

Many corridor-length and non-corridor-length potential solutions to I-81 were received from the public and government agencies during the scoping process. Some of the concepts that emerged from the Scoping Process involved improving I-81 for its entire length in Virginia, while others called for improvements in localized areas of I-81 (*e.g.*, highways on new location including bypasses, interchange improvements, truck climbing lanes, and auxiliary lanes). Only the corridor-length concepts were retained as stand-alone concepts because the study evaluates deficiencies and potential solutions on a corridor-length basis. Non-corridor-length concepts were eliminated from consideration as stand-alone concepts. Some of the ideas noted below may be evaluated in Tier 2 if one or more of the “Build” concepts (or portions of “Build” concepts) are advanced. They include:

- Additional interchanges to alleviate traffic on local roadways and other existing interchanges;
- Incorporation of existing and planned bike trails in the area and inclusion of bicycle facilities crossing I-81;
- Additional and improved rest areas;
- Consideration of park and ride facilities with bus service;
- Removal of the I-81/I-77 overlap by rerouting I-77 or I-81;
- A separate parallel four- to six-lane interstate highway from near the Tennessee state line to north of Abingdon. Existing I-81 would be designated Business I-81 and the new interstate would be primarily for through traffic; and
- Preservation or improved accessibility of non-motorized traffic (pedestrians, bicycles, horses, and buggies) from one side of I-81 to the other.

The only corridor-length concept that emerged from the Scoping Process that was eliminated from consideration was an alternate corridor for heavy truck traffic, possibly a new interstate between I-81 and I-95. An entirely new interstate facility is not a reasonable solution to the I-81 corridor capacity and safety deficiencies and is, therefore not under consideration.

3.1.2 Concepts Considered

The No-Build Concept and 211 combinations of TSM, road improvements, rail improvements and various toll scenarios were considered. Their ability to address the capacity portion of the Purpose and Need of the *I-81 Corridor Improvement Study* was identified in the form of the number of miles of I-81 that would continue to operate below level of service standards after the concept was built (described in Chapter 2, *Purpose and Need*) and the number of miles where excess capacity would be provided. Excess capacity was defined as the provision of at least one more lane than the number of lanes required to provide level of service at or above level of service standards. For example, if a lane could be removed from a section, but the section still operated at or above the level of service standard, the segment was considered to provide excess capacity. Each concept was evaluated for 650 miles, which is comprised of 325 miles in each direction.

The cost for the improvement concepts included estimated construction costs, right-of-way costs, and engineering costs expressed in year 2005 and year 2015 dollars. A compounded annual inflation factor of 3.89 percent was used to project the year 2015 costs, which is consistent with VDOT's standard cost estimating escalation assumptions.

The analysis of the No-Build and 211 combinations of TSM, road improvements, rail improvements and various toll scenarios is presented in Section 3.2 below. The findings of this analysis are that all consistent, corridor-length concepts are inefficient at addressing corridor-length capacity as stand-alone concepts. All either provide insufficient capacity to address corridor needs or provide excess capacity. However, the analysis indicates that many of these concepts are appropriate for certain sections of I-81. Therefore, different concepts may be combined and applied only to certain areas if a build concept (or portions of a build concept) is advanced.

3.1.3 Toll Scenarios

The effect of the tolls was estimated by modeling diversions from I-81 to other transportation facilities for trucks and cars or just trucks. Generally, the higher the toll, the more diversion of traffic from I-81 to other facilities. This diversion lowers the capacity improvement requirements on the I-81 mainline. In addition, traffic that diverts to I-81 due to the improved efficiency created by the proposed improvements (*i.e.*, those that would divert from their normal travel pattern on a facility other than I-81 to I-81 if it were improved) was accounted for in the projection of traffic for each concept.

Five toll scenarios were tested for each concept evaluated:

- No toll
- Low toll for all vehicles (\$0.08 per mile per vehicle (car) / \$0.04 per mile per axle (truck))
- High toll for all vehicles (\$0.14 per mile per vehicle (car) / \$0.07 per mile per axle (truck))

- Low toll for only commercial vehicles (\$0.04 per mile per axle (truck))
- High toll for only commercial vehicles (\$0.07 per mile per axle (truck))

With no toll, capacity and safety improvements along I-81 attract traffic that ordinarily would have taken a different route (either local, regional, or long distance), but is now attracted to a new, improved facility. As toll rates are introduced, travel patterns begin to shift back to those present prior to improvement of the facility as vehicles divert to their original route choices to avoid additional costs. The toll diversion involved a modeling effort described in the *I-81 Corridor Improvement Study Toll Impact Study*. The low and high toll rates were derived from national research and represent a reasonable rate that could be charged. Generally, the higher the toll, the more diversion of traffic from I-81 to other facilities, which reduces the number of required lanes on I-81.

A summary of the average diversion estimates due to tolls is shown in Table 3.1-1. These diversion estimates represent the percentage of vehicles diverting from an improved I-81 due to tolls. As a result of these diversions, the capacity needs on I-81 in 2035 are slightly reduced. Under the low toll scenario, nine miles of the highway would need only one additional lane in each direction (instead of two additional lanes per direction). With a high toll, this number increases to 64 miles.

Table 3.1-1 Summary of Diversion Estimates Due to Tolls

Vehicle Diversions	Tolls for All Vehicles		Tolls for All Commercial Vehicles	
	Low Toll	High Toll	Low Toll	High Toll
Total Vehicles				
Average Diversion from I-81	8%	16%	2%	9%
Trucks				
Average Diversion from I-81	3%	11%	12%	25%

The traffic effects of toll diversion from I-81 to other facilities are discussed in the *I-81 Corridor Improvement Study Transportation Technical Report and the I-81 Corridor Improvement Study Toll Impact Report*. The environmental effects of toll diversion from I-81 to other facilities are qualitatively discussed in Chapter 5, *Environmental Consequences*. When reviewing this diversion analysis it is important to remember that the percentages listed tend to be higher on smaller facilities as differences in smaller numbers can be more dramatic when expressed as a percent change. Therefore, it can be concluded that while the high value percentages may seem high, the actual impact resulting from the number of vehicles is low.

An expanded I-81 without tolls would generally improve conditions on U.S. Route 11 and other local roadways in the I-81 study area by diverting traffic from these local roadways to the interstate. This is especially true in the more populated and urban areas.

The implementation of a low toll on I-81 would gradually begin to shift traffic back to the local roadway network, although in most locations traffic volumes would still be below 2035 No-Build predictions. However, the implementation of higher tolls on I-81 would result in slight increases in local traffic throughout much of the study area as compared to the No-Build condition. Even though about half of the traffic would divert to U.S. Route 11, the resulting increase is slight for this type of roadway (a rural principal arterial) and the overall impact is low. The impact of tolls on the traffic operations of the local roadways would not be substantial. Areas with a high potential for local roadway impacts are sporadic throughout the corridor. Traffic diverting to other parallel facilities would experience an even smaller impact.

An expanded I-81 without tolls would generally improve conditions on U.S. Route 11 and other local roadways in the I-81 study area by diverting traffic from these local roadways to the interstate. This is especially true in the more populated and urban areas.

The inclusion of tolls would have a slight effect on the I-81 cross-section necessary to meet the 2035 traffic demands. This effect is noticeable in the area surrounding Abingdon and from Harrisonburg to Strasburg, where as a result of tolls, the necessary cross-section can be reduced by one-lane in each direction (the exact length of this reduction depends on the toll scenario). The effects of tolling on the required cross-section would be explored in more detail in Tier 2 if a "Build" concept (or portion of a "Build" concept) is advanced to Tier 2.

Large volume increases over the No-Build condition are not anticipated as a result of toll diversion at any location on U.S. Route 11. In most locations, with an improved I-81, traffic volumes along U.S. Route 11 would be below 2035 No-Build projections. With regard to trucks, if all vehicles are tolled, an expanded I-81 would decrease truck traffic on local roadways to levels below what are projected under 2035 No-Build conditions.

It is inconsistent with Federal law to toll an interstate facility unless improvements are made to the facility. In addition, the use of tolls collected on an interstate to make improvements to other modes of transportation (*e.g.*, railroads) is prohibited. Therefore, concepts that considered tolls, but did not include highway improvements, are not considered viable.

3.2 Improvement Concepts

The potential improvement concepts include planned roadway improvements at the Tennessee and West Virginia state lines and provide adequate distance for transition. All "Build" improvement concepts include TSM improvements and account for traffic that diverts to I-81 because of its increased capacity.

The primary criterion used to evaluate the effectiveness of each concept in addressing the capacity needs of I-81 was traffic operations. The evaluation of each improvement concept included:

- alternative operation assumptions (*e.g.*, toll scenarios of no tolls, a low and high toll for all vehicles and a low and high toll for commercial vehicles only);
- operational results for exclusive and non-exclusive lanes (when separation of lanes were included in a concept); and
- operational results for general purpose lanes.

The mainline analyses were conducted by segment, from interchange to interchange, based on the most severe grade that exists between interchanges. This represents the worse case operating condition for each segment. If a “Build” concept (or portion of a “Build” concept) is advanced to Tier 2, a more detailed analysis would be preformed in Tier 2.

The following paragraphs describe each concept and their ability to meet the needs of I-81 in Virginia. The operational results for each concept were evaluated for 650 miles, which is comprised of 325 miles in each direction.

Costs are presented in 2005 dollars and 2015 dollars. The 2005 dollars represent today’s cost and the 2015 dollars coincide with the possible completion of the construction of the improvements. A more detailed description of the development of the costs for the improvements is presented in *the I-81 Corridor Improvement Study Concept Development and Analysis Technical Report*.

3.2.1 No-Build Concept

Description

I-81 is predominantly a four-lane limited access interstate highway; however, there are two areas with a six-lane cross-section (from Mileposts 0 to 7 near Bristol and from Mileposts 72 to 81 (the I-77 overlap area)). The No-Build Concept is defined as the I-81 roadway as it exists in 2005 plus 16 construction projects included in the *Virginia Transportation Six-Year Improvement Program for Fiscal Years 2006 – 2011* and Metropolitan Planning Organizations’ Long Range Plans that are fully funded through construction. It was assumed that these projects with funding commitments would be completed by 2035.

The No-Build Concept does not include any future potential improvements that are not currently funded through construction. Table 3.2-1 summarizes the roadway construction projects that are included in the No-Build Concept. Rail improvements necessary to maintain the 2005 level of service on the Norfolk Southern rail system in Virginia were assumed to be included in the No-Build Concept.

Table 3.2-1 Funded I-81 Projects Included in No-Build Concept¹

Map ID #	County	Milepost	Description
1	Montgomery	109	Grade change at ramp termini
2	Roanoke	142	Widen with signals at Exit 142 (Route 419) ramps
3	Botetourt	162	Widen northbound and southbound bridge
4	Rockbridge	180	I-81 Bridge and approaches
5	Rockbridge	185	Northbound and southbound approaches and bridges over Buffalo Creek
6	Rockbridge	185	Northbound truck climbing lane
7	Rockbridge	191	Northbound and southbound approaches and bridges over Maury River
8	City of Harrisonburg	244	Bridge Widening (four lanes) & replacement – safety improvement
9	Frederick	307	Safety improvements at Exit 307
10	Frederick	310	Safety Improvements at Exit 310
11	Frederick	313	Widen northbound and southbound bridges over Abram's Creek and extend acceleration and deceleration lanes
12	Frederick	313	Interchange safety improvement
13	Frederick	315	Safety improvements at Exit 315
14	Frederick	317	Safety improvements at Exit 317
15	Frederick	320	Safety improvements, extend southbound rest area acceleration lanes
16	Frederick	323	Bridge widening – safety improvement

Source: Virginia Transportation Six-Year Improvement Program for Fiscal Years 2006–2011

¹ The No-Build analysis assumes these projects would be completed prior to 2035.

Ability to Meet Needs

Safety

There are three general objectives for increasing highway safety: reduce highway fatalities; reduce overall highway crashes; and improve heavy vehicle safety on the highway. As the volumes increase and the geometric deficiencies remain, the overall safety on I-81 would decline.

Capacity

2035 No-Build traffic operating conditions are illustrated in Table 3.2-1 in the *I-81 Corridor Improvement Study Concept Development Technical Report*, which indicates that:

- 594 miles (91 percent) would operate below the level of service standard
- 18 miles (0.3 percent) of I-81 would provide more lanes than are needed

Figure 2-6 presented a summary of mainline operations along I-81. In summary, as the volume of traffic continues to increase in the future, the delays and congestion experienced along I-81 and at each interchange would not only worsen during the peak hours, but the level of congestion is expected to expand to longer periods of the day and to a greater number of days.

Cost

The funds to build those improvements listed in Table 3.2-1 (above) are already programmed for construction in the *Virginia Transportation Six-Year Improvement Program for Fiscal Years 2006–2011*.

3.2.2 Transportation System Management Concept (TSM)

Description

This improvement concept includes safety improvements (*e.g.*, lengthening of acceleration lanes at interchanges), truck climbing lanes, Intelligent Transportation System (ITS) elements, and Transportation Demand Management (TDM) measures.

TSM measures would include the following projects:

- Increasing weaving distance between northbound ramps at Exits 14 and 94;
- Increasing weaving distance between southbound ramps at Exits 220, 221, 222, 247;
- Increasing acceleration and/or deceleration lane lengths at Exits 132, 137, 140, 141, 143, 146, 156, 162, 167, 168, 180, 323;
- Constructing southbound truck climbing lanes at Mileposts 119-128, 166.5-167.5, 182-184, 186.8-190, 234.6-236.4;
- Constructing northbound truck climbing lanes at Mileposts 165.7-166.8, 168.7-174, 184.2-186.1, 191.7-202, 236.5-237.5;
- Improving ramp geometry and/or length at Exits 35, 39, 47, 50, 67, 70, 80, 126, 251, 291; and

- Improving ramp geometry and/or length at the rest areas at northbound Exit 129.3 and southbound Exit 158.

TDM measures, such as the use of park and ride facilities and increased use of carpooling, were accounted for by reducing traffic projections by three percent in rural areas and by five percent in urbanized areas. This additional trip reduction did not decrease the demand on I-81 sufficiently to reduce the amount of additional capacity needed. Based on this finding, the three to five percent reduction for TDM was not used in the evaluation of the other stand-alone concepts. Therefore, the evaluation results are slightly conservative.

Ability to Meet Needs

Safety

Safety along some of I-81 would improve with the TSM Concept because of the increased acceleration and deceleration lane lengths noted above.

Capacity

TSM improvements do not address capacity needs on I-81. Traffic operating conditions for each toll scenario are illustrated in Table 3.2-1 in the *I-81 Corridor Improvement Study Concept Development Technical Report*, which indicates that:

- 594 miles (91 percent) would operate below the level of service standard
- 18 miles (0.3 percent) of I-81 would provide more lanes than are needed

Cost

The TSM Concept would cost approximately \$0.08 billion in 2005 dollars and \$0.1 billion in 2015 dollars.

3.2.3 Rail Concepts

The rail lines that are included in this study are all owned by Norfolk Southern Railroad. There are currently no federal highway funding categories that VDOT can use to implement improvements to privately owned rail lines as part of this study. Any improvements to such railroads would, in fact, be at the discretion of Norfolk Southern Railroad.

Multimodal interface opportunities such as new intermodal terminals, access roads to existing terminals or proposed terminals are potential interface enhancements that can be provided in the I-81 corridor. The recent federal transportation law (SAFETEA-LU) has specific appropriations for these types of interface facilities as well as other improvements that the Commonwealth of Virginia could take advantage of in the I-81 corridor. In addition to



\$41.5 million of designated funding to “manage freight movement and safety improvements along I-81, SAFETEA-LU also included a number of general freight finance provisions that Virginia may be able to take advantage of in obtaining additional funds to improve privately owned rail lines. Freight provisions of SAFETEA-LU that may offer opportunities to improve rail freight movement along the I-81 corridor include:

- Section 1601: Transportation Infrastructure Finance and Innovation Act (TIFIA)
- Section 1602: State Infrastructure Banks (SIB)
- Section 11-1143 Tax-exempt Financing of Highway Projects and Rail Truck Transfer Facilities (Private Activity Bonds)
- Section 9002: Capital Grants for Rail Line Relocation Projects
- Section 9003: Rehabilitation and Improvement Financing

In addition to the freight provisions of SAFETEA-LU, a number of its project programs also offer the possibility of providing funds for rail improvements, including:

- Section 1301: Projects of National and Regional Significance
- Section 1302: National Corridor Infrastructure Improvement Program
- Section 1934: Transportation Improvements
- Section 1701: High Priority Projects Program

The rail concepts examined are described in more detail in Sections 3.2.4 through 3.2.7. These rail concepts have different effects on the diversion of freight from roadway to rail, but are similar in that they only slightly reduce the need for increased capacity on I-81. The freight diversion methodology and results are documented in the *I-81 Corridor Improvement Study Transportation Technical Report*.

3.2.4 Rail Concept 1

Description

This improvement concept includes minor improvements to the Norfolk Southern Piedmont Line from the West Virginia state line to Manassas, including improvements to one of the most congested sections of the Piedmont Line, the section from Front Royal to Manassas. The improvements would address both capacity and operating speed limitations. The *I-81 Corridor Improvement Study Transportation Technical Report* includes details of the types of improvements included in this concept. Figure 3-1 illustrates the location of Rail Concept 1.

Ability to Meet Needs

Safety

Because of the diversion of some freight from roadway to rail, safety along I-81 would likely be modestly improved with Rail Concept 1 because there would be slightly fewer trucks traveling along the highway in 2035 with Rail 1 Concept improvements than there would be in 2035 with no rail improvements.

Capacity

Does not address capacity needs along I-81 because not enough freight diverts from the roadway to the railroad. Additionally, the need for additional capacity (or lanes) is not reduced by this concept. Traffic operating conditions are illustrated in Table 3.2-1 in the *I-81 Corridor Improvement Study Concept Development Technical Report*, which indicates that:

- 480 miles (74 percent) would operate below the level of service standard
- 4 miles (0.01 percent) of I-81 would provide more lanes than are needed

Cost

Rail Concept 1 would cost approximately \$0.1 billion in 2005 dollars and \$0.14 billion in 2015 dollars.

3.2.5 Rail Concept 2

Description

This improvement concept includes improvements to the Norfolk Southern Piedmont Line within the Commonwealth of Virginia, with major improvements occurring in nine sections. Rail Concept 2 was proposed in the *Northeast-Southeast-Midwest Corridor Marketing Study* as the Virginia-based investment scenario. This concept is focused on improvements to the Piedmont Line, including improvements between Manassas and Front Royal (as with Rail Concept 1). However, Rail Concept 2 assumes rail operations of up to six pairs of trains daily in each direction (12 total trains). Details of the types of improvements included in this concept are outlined in the *I-81 Corridor Improvement Study Transportation Technical Report*. Figure 3-2 illustrates the location of Rail Concept 2 improvements.

Ability to Meet Needs

Safety

Because of the diversion of some freight from roadway to rail, safety along I-81 would likely be modestly improved because there would be fewer trucks traveling along the highway in 2035 with Rail 2 improvements than there would be in 2035 with no rail improvements.

Capacity

Although this concept would reduce the number of additional lanes needed in 2035 by 23 miles, it does not sufficiently address the capacity needs along I-81 in 2035. Traffic operating conditions are illustrated in Table 3.2-1 in the *I-81 Corridor Improvement Study Concept Development Technical Report*, which indicates that:

- 439 miles (68 percent) would operate below the level of service standard
- 4 miles (0.01 percent) of I-81 would provide more lanes than are needed

Cost

Rail Concept 2 would cost approximately \$0.5 billion in 2005 dollars and \$0.7 billion in 2015 dollars.

3.2.6 Rail Concept 3

Description

This improvement concept includes all improvements to the Norfolk Southern Piedmont Line included in Rail Concept 2, as well as minor improvements to the Norfolk Southern Shenandoah Line. Railroad operations on both the Shenandoah and Piedmont Lines are quite heavy, but the Piedmont is a faster route and carries the majority of the higher speed traffic. The new operations would add an additional 12 trains (six in each direction) north of Lynchburg. The Piedmont Line south of Lynchburg would handle eight new trains per day and west of Lynchburg, four per day. The *I-81 Corridor Improvement Study Transportation Technical Report* outlines the details of the types of improvements included in this concept. Figure 3-3 illustrates the location of Rail Concept 3 improvements.

Ability to Meet Needs

Safety

Because of the diversion of some freight from roadway to rail, safety along I-81 would likely be modestly improved because there would be fewer trucks traveling along the highway in 2035 with Rail 3 improvements than there would be in 2035 with no rail improvements.

Capacity

Although this concept would reduce the number of additional lanes needed in 2035 by 30 miles, it does not sufficiently address the capacity needs along I-81 in 2035. Traffic operating conditions are illustrated in Table 3.2-1 in the *I-81 Corridor Improvement Study Concept Development Technical Report*, which indicates that:

- 400 miles (62 percent) would operate below the level of service standard
- 4 miles (0.01 percent) of I-81 would provide more lanes than are needed

Cost

Rail Concept 3 would cost approximately \$0.5 billion in 2005 dollars and \$0.7 billion in 2015 dollars.

3.2.7 Rail Concept 4

Description

This improvement concept includes full-level improvements to the Norfolk Southern Shenandoah Line and new rail freight hauling technology that interfaces with intermodal centers at strategic locations along the I-81 corridor. This concept was proposed during the Scoping Process by Rail Solution, a rail advocacy group. This rail concept was described as a modern, dual-track, high speed rail line, grade separated from all road crossings, capable of carrying intermodal freight and passenger trains at speeds of up to 80 miles per hour along Norfolk Southern's line between Harrisburg, Pennsylvania, and Knoxville, Tennessee, and possibly beyond to Memphis and New Orleans.¹ Figure 3-4 illustrates the location of the Rail Concept 4 improvements.

Ability to Meet Needs

Safety

Because of the diversion of some freight from roadway to rail, safety along I-81 would likely be modestly improved because there would be fewer trucks traveling along the highway in 2035 with Rail 4 improvements than there would be in 2035 with no rail improvements.

Capacity

Although this concept would reduce the number of additional lanes needed in 2035 by 47 miles, it does not sufficiently address the capacity needs along I-81 in 2035. Traffic operating

¹ Source: Rail Solution web page <http://www.railsolution.org/>

conditions are illustrated in Table 3.2-1 in the *I-81 Corridor Improvement Study Concept Development Technical Report*, which indicates that:

- 396 miles (61 percent) would operate below the level of service standard
- 4 miles (0.01 percent) of I-81 would provide more lanes than are needed

Cost

Rail Concept 4 would cost approximately \$3.7 billion in 2005 dollars and \$5.4 billion in 2015 dollars.

Table 3.2-2 illustrates the percent of trucks that are projected to divert and the cost of each rail concept.

Table 3.2-2 Rail Truck Diversion Percentages and Costs

Rail Concept #	% Truck Diversion	Cost (in millions)
Rail Concept 1	0.7	\$111
Rail Concept 2	2.9	\$496
Rail Concept 3	3.5	\$509
Rail Concept 4	5.8	\$3,700

3.2.8 Roadway Concepts

Roadway concepts were evaluated as consistent corridor-length concepts, which meant they either made the number of lanes in each direction equal for the entire length of I-81 in Virginia, or added an equal number of lanes to the existing lanes for the entire length of I-81 in Virginia.

Add 1 Lane Concept

Description

This improvement concept provides one additional lane in each direction and provides upgraded shoulder widths for the entire length of I-81 in Virginia.

Ability to Meet Needs

Safety

Safety along I-81 would be somewhat improved due the increased shoulder widths and an additional lane of capacity in each direction throughout the corridor.



Capacity

Traffic operating conditions for each toll scenario are illustrated in Table 3.2-1 in the *I-81 Corridor Improvement Study Concept Development Technical Report*, which indicates that:

- 237 to 396 miles (36 to 61 percent) would operate below the level of service standard
- 37 to 131 miles (6 to 20 percent) would provide more lanes than are needed

Cost

Adding one lane in each direction would cost approximately \$5.1 billion in 2005 dollars and \$7.5 billion in 2015 dollars.

Add 2 Lanes Concept

Description

This improvement concept provides two additional lanes and upgraded shoulder widths in each direction for the entire length of I-81 in Virginia.

Ability to Meet Needs

Safety

Safety along I-81 would be somewhat improved due the increased shoulder widths and an additional two lanes of capacity in each direction throughout the corridor.

Capacity

Traffic operating conditions for each toll scenario are illustrated in Table 3.2-1 in the *I-81 Corridor Improvement Study Concept Development Technical Report*, which indicates that:

- 20 to 76 miles (3 to 12 percent) would operate below the level of service standard
- 254 to 413 miles (39 to 64 percent) would provide more lanes than are needed

Cost

Adding two lanes in each direction would cost approximately \$7.8 billion in 2005 dollars and \$11.4 billion in 2015 dollars.

Add 3 Lanes Concept

Description

This improvement concept provides three lanes and upgraded shoulder widths in each direction for the entire length of I-81 in Virginia.

Ability to Meet Needs

Safety

Safety along I-81 would be somewhat improved due the increased shoulder widths and an additional three lanes of capacity in each direction throughout the corridor.

Capacity

Traffic operating conditions for each toll scenario are illustrated in Table 3.2-1 in the *I-81 Corridor Improvement Study Concept Development Technical Report*, which indicates that:

- 0 miles (0 percent) would operate below the level of service standard
- 574 to 630 miles (88 to 97 percent) would provide more lanes than are needed

Cost

Adding three lanes in each direction would cost approximately \$11.2 billion in 2005 dollars and \$16.4 billion in 2015 dollars.

Uniform 6-Lane Concept

Description

This improvement concept provides an additional lane, where necessary, to make the entire corridor a consistent three lanes in each direction and upgrades shoulder widths for the entire length of I-81 in Virginia.

Ability to Meet Needs

Safety

Safety along I-81 would be somewhat improved due to the increased shoulder widths throughout the corridor and an additional lane of capacity in each direction for much of the corridor.



Capacity

Traffic operating conditions for each toll scenario are illustrated in Table 3.2-1 in the *I-81 Corridor Improvement Study Concept Development Technical Report*, which indicates that:

- 242 to 411 miles (37 to 63 percent) would operate below the level of service standard
- 24 to 108 miles (4 to 17 percent) would provide more lanes than are needed

Cost

Adding one lane in each direction, where necessary, to provide three lanes in each direction for the entire length of I-81 in Virginia would cost approximately \$4.9 billion in 2005 dollars and \$7.2 billion in 2015 dollars.

Uniform 8-Lane Concept

Description

This concept provides additional lanes, where necessary, to make the entire corridor a consistent four lanes in each direction and upgrades shoulder widths for the entire length of I-81 in Virginia.

Ability to Meet Needs

Safety

Safety along I-81 would be somewhat improved due to the increased shoulder widths throughout the corridor and an additional two lanes of capacity in each direction for much of the corridor.

Capacity

Traffic operating conditions for each toll scenario are illustrated in Table 3.2-1 in the *I-81 Corridor Improvement Study Concept Development Technical Report*, which indicates that:

- 20 to 76 miles (3 to 12 percent) would operate below the level of service standard
- 239 to 408 miles (37 to 63 percent) would provide more lanes than are needed

Cost

Adding a third and fourth lane, where necessary, to provide four lanes in each direction would cost approximately \$7.5 billion in 2005 dollars and \$11.0 billion in 2015 dollars.

3.2.9 Combination Concepts

Roadway and rail improvement concepts were combined to assess their effectiveness in addressing the needs of the I-81 corridor. Rail Concept 3 was chosen as the most appropriate rail concept to combine with roadway concepts because it provides the most diversion of freight from truck to rail per dollar of investment.

Combination Concept 1

Description

This improvement concept adds one lane in each direction and upgrades the shoulder widths for the entire length of I-81 in Virginia in combination with Rail Concept 3.

Ability to Meet Needs

Safety

Safety along I-81 would be improved due to the increased shoulder widths throughout the corridor, increased capacity throughout the corridor, and the reduction in traffic volumes created by the diversion of freight from trucks to the railroad.

Capacity

Traffic operating conditions for each toll scenario are illustrated in Table 3.2-1 in the *I-81 Corridor Improvement Study Concept Development Technical Report*, which indicates that:

- 169 to 378 miles (26 to 58 percent) would operate below the level of service standard
- 67 to 150 miles (10 to 23 percent) would provide more lanes than are needed

Cost

Adding one lane in each direction in combination with improving the railroad as described in Rail Concept 3 would cost approximately \$5.6 billion in 2005 dollars and \$8.2 billion in 2015 dollars.

Combination Concept 2

Description

This improvement concept provides two additional lanes and upgrades shoulder widths in each direction for the entire length of I-81 in Virginia in combination with Rail Concept 3.



Ability to Meet Needs

Safety

Safety along I-81 would be improved due to the increased shoulder widths throughout the corridor, increased capacity throughout the corridor, and the reduction in traffic volumes created by the diversion of freight from trucks to the railroad.

Capacity

Traffic operating conditions for each toll scenario are illustrated in Table 3.2-1 in the *I-81 Corridor Improvement Study Concept Development Technical Report*, which indicates that:

- 1 to 62 miles (0 to 10 percent) would operate below the level of service standard
- 272 to 481 miles (42 to 74 percent) would provide more lanes than are needed

Cost

Adding two lanes in each direction for the entire length of I-81 in Virginia in combination with Rail Concept 3 would cost approximately \$8.3 billion in 2005 dollars and \$12.2 billion in 2015 dollars.

Combination Concept 3

Description

This improvement concept provides three additional lanes and upgrades shoulder widths in each direction for the entire I-81 corridor in Virginia in combination with Rail Concept 3.

Ability to Meet Needs

Safety

Safety along I-81 would be improved due to the increased shoulder widths throughout the corridor, increased capacity throughout the corridor, and the reduction in traffic volumes created by the diversion of freight from trucks to the railroad.

Capacity

Traffic operating conditions for each toll scenario are illustrated in Table 3.2-1 in the *I-81 Corridor Improvement Study Concept Development Technical Report*, which indicates that:

- 0 miles (0 percent) would operate below the level of service standard
- 588 to 649 miles (90 to 100 percent) would provide more lanes than are needed



Cost

Adding three lanes in each direction for the entire length of I-81 in Virginia in combination with Rail Concept 3 would cost approximately \$11.7 billion in 2005 dollars and \$17.1 billion in 2015 dollars.

Combination Concept 4

Description

This improvement concept adds one lane direction, where necessary, to provide three lanes in each direction and upgrades the shoulder widths for the entire length of I-81 in Virginia (the Uniform 6-Lane Concept) in combination with Rail Concept 3.

Ability to Meet Needs

Safety

Safety along I-81 would be improved due to the increased shoulder widths throughout the corridor, increased capacity throughout the corridor, and the reduction in traffic volumes created by the diversion of freight from trucks to the railroad.

Capacity

Traffic operating conditions for each toll scenario are illustrated in Table 3.2-1 in the *I-81 Corridor Improvement Study Concept Development Technical Report*, which indicates that:

- 174 to 393 miles (27 to 60 percent) would operate below the level of service standard
- 54 to 127 miles (8 to 20 percent) would provide more lanes than needed

Cost

Adding one lane in each direction, as needed, to provide three lanes in each direction for the entire corridor in combination with Rail Concept 3 would cost approximately \$5.4 billion in 2005 dollars and \$7.9 billion in 2015 dollars.

Combination Concept 5

Description

This improvement concept provides two lanes in each direction, where necessary, to provide four lanes in each direction and upgrades shoulder widths for the entire length of I-81 in Virginia (the Uniform 8-Lane Concept) in combination of Rail Concept 3.

Ability to Meet Needs

Safety

Safety along I-81 would be improved due to the increased shoulder widths throughout the corridor, increased capacity throughout the corridor, and the reduction in traffic volumes created by the diversion of freight from trucks to the railroad.

Capacity

Traffic operating conditions for each toll scenario are illustrated in Table 3.2-1 in the *I-81 Corridor Improvement Study Concept Development Technical Report*, which indicates that:

- 1 to 62 miles (0 to 10 percent) would operate below the level of service standard
- 257 to 476 miles (40 to 73 percent) would provide more lanes than are needed

Cost

Adding two lanes in each direction, where necessary, to provide four lanes in each direction for the entire length of I-81 in Virginia (the Uniform 8-Lane Concept) in combination of Rail Concept 3 would cost approximately \$8.0 billion in 2005 dollars and \$11.7 billion in 2015 dollars.

3.2.10 Separated Lane Concepts

Concepts involving the separation of lanes (in the same direction of travel) were considered and were divided into two types: those involving exclusive separated lanes and those involving non-exclusive separated lanes. Exclusive lanes are barrier-separated lanes with separate interchange ramps to all the interchanges along the roadway. Non-exclusive lanes provide a rumble strip between the separated lanes and the other lanes, which allows vehicles in the separated lanes to merge into the other lanes to use the existing interchange ramps. Separated lane concepts were evaluated with the same toll scenarios as the other concepts, with and without Rail Concept 3 and in combination with the addition of zero, one, and two general purposes lanes in each direction.

Separated Lane Concept 1

Description

This improvement concept provides one exclusive barrier-separated truck lane in each direction of travel in combination with the addition of one or two non-separated lanes and upgraded shoulder widths in each direction. It was evaluated with and without Rail Concept 3 as well as with the previously identified toll scenarios.

Ability to Meet Needs

Safety

Passenger cars and trucks are 100 percent separated and safety would improve on the general purpose lanes due to wider shoulders. However, this concept does not provide safe operating conditions due to the lack of ability to pass slower vehicles and a lack of maneuverability in the truck lane in the event of an emergency or evacuation. Therefore it is not a viable concept.

Capacity

Traffic operating conditions for each toll scenario and with and without Rail Concept 3 are illustrated in Table 3.2-1 in the *I-81 Corridor Improvement Study Concept Development Technical Report*, which indicate that:

- In the car lanes, 1 to 14 miles (0 to 2 percent) would operate below the level of service standard
- In the truck lanes, 191 to 384 miles (29 to 59 percent) would operate below the level of service standard
- In the car lanes, 302 to 482 miles (46 to 74 percent) would provide more lanes than are needed
- In the truck lanes, 0 miles (0 percent) would provide more lanes than are needed

Cost

Separated Lane Concept 2 in combination with Rail Concept 3 and the addition of one or two non-separated lanes would cost approximately \$11.2 – \$12.7 billion in 2005 dollars and \$16.4 – \$18.6 billion in 2015 dollars.

Separated Lane Concept 2

Description

This improvement concept provides two exclusive barrier-separated truck lanes in each direction of travel combined with the addition of zero, one, or two non-separated lanes and upgraded shoulder widths in each direction. It was evaluated with and without Rail Concept 3 as well as with the previously identified toll scenarios.

Ability to Meet Needs

Safety

Passenger cars and trucks are 100 percent separated and safety would improve on the general purpose lanes due to wider shoulders.

Capacity

Traffic operating conditions for each toll scenario and with and without Rail Concept 3 are illustrated in Table 3.2-1 in the *I-81 Corridor Improvement Study Concept Development Technical Report*, which indicate that:

- In the car lanes, 0 to 348 miles (0 to 54 percent) would operate below the level of service standard
- In the truck lanes, 0 to 65 miles (0 to 10 percent) would operate below the level of service standard
- In the car lanes, 22 to 649 miles (3 to 99 percent) would provide more lanes than are needed
- In the truck lanes, 266 to 459 miles (41 to 71 percent) would provide more lanes than are needed

Cost

Separated Lane Concept 2 in combination with Rail Concept 3 and the addition of one or two non-separated lanes would cost approximately \$11.2 – \$13.0 billion in 2005 dollars and \$16.4 – \$19.0 billion in 2015 dollars.

Separated Lane Concept 3

Description

This improvement concept provides two non-exclusive separated truck lanes in each direction of travel in combination with the addition of zero, one, or two non-separated lanes and upgraded shoulder widths in each direction. It was evaluated with and without Rail Concept 3 as well as with the previously identified toll scenarios.

Since this concept involves trucks entering and exiting at the existing interchanges, the heavy vehicle traffic volume networks (presented in the *Transportation Technical Report*) were reviewed to determine where trucks are entering and exiting I-81. Based on this review, it is estimated that approximately 20 percent of the total truck volume would be mixed with passenger cars at any given point. This 20 percent represents trucks crossing over the rumble

strip either into or out of the separated lanes and includes the adequate time necessary for trucks to make these maneuvers.

Ability to Meet Needs

Safety

Non-exclusive separated lanes allow motorists in the separated lanes to weave across other lanes in order to use exit ramps and motorists using entrance ramps to weave across lanes to access the separated lanes. As traffic volume increases, weave segments become deficient in their ability to process demand safely and efficiently; leading to an increase in crash incidents. In addition, there are current national and local policies to eliminate weave sections on interstates. The creation of many weave and multi-merge sections is not supported by these policies and may not address the existing safety deficiencies along I-81. If a "Build" concept (or portion of a "Build" concept) is advanced to Tier 2, specific issues regarding weaving and how to appropriately and safely accommodate the maneuvers in a non-exclusive separated lane concept could be evaluated.

Capacity

Traffic operating conditions for each toll scenario and with and without Rail Concept 3 are illustrated in Table 3.2-1 in the *I-81 Corridor Improvement Study Concept Development Technical Report*, which indicate that:

- In the truck lanes, 0 to 10 miles (0 to 2 percent) would operate below the level of service standard
- In the general purpose lanes, 240 to 495 miles (37 to 76 percent) would operate below the level of service standard
- In the truck lanes, 422 to 556 miles (65 to 86 percent) would provide more lanes than are needed
- In the general purpose lanes, 10 to 74 miles (2 to 11 percent) would provide more lanes than are needed

Cost

Separated Lane Concept 3 in combination with Rail Concept 3 and the addition of one or two non-separated lanes would cost approximately \$9.3 – \$10.8 billion in 2005 dollars and \$13.6 – \$15.8 billion in 2015 dollars.

Separated Lane Concept 4

Description

This concept provides two exclusive barrier-separated car lanes in each direction of travel combined with the addition of zero, one, or two non-separated lanes and upgraded shoulder widths in each direction. It was evaluated with and without Rail Concept 3 as well as with the previously identified toll scenarios.

Ability to Meet Needs

Safety

Passenger cars and trucks are 100 percent separated and safety would improve on the general purpose lanes due to wider shoulders.

Capacity

Traffic operating conditions for each toll scenario and with and without Rail Concept 3 are illustrated in Table 3.2-1 in the *I-81 Corridor Improvement Study Concept Development Technical Report*, which indicate that:

- In the car lanes, 168 to 362 miles (25 to 56 percent) would operate below the level of service standard
- In the truck lanes, 0 to 65 miles (0 to 10 percent) would operate below the level of service standard
- In the car lanes, 8 to 76 miles (1 to 12 percent) would provide more lanes than are needed
- In the truck lanes, 279 to 650 miles (43 to 100 percent) would provide more lanes than are needed

Cost

Separated Lane Concept 4 in combination with Rail Concept 3 and the addition of one or two non-separated lanes would cost approximately \$11.2 – \$13.0 billion in 2005 dollars and \$16.4 – \$19.0 billion in 2015 dollars.

Separated Lane Concept 5

Description

This improvement concept provides two non-exclusive separated car lanes in each direction of travel combined with the addition of zero, one, or two non-separated lanes and upgraded

shoulder widths in each direction. It was evaluated with and without Rail Concept 3 as well as with the previously identified toll scenarios.

Cars can travel in either the non-exclusive car lanes or the non-separated lanes. This concept provides the same separation as Separated Lane Concept 4, but passenger cars have the option of traveling with trucks and it is estimated that approximately 20 percent of passenger cars would travel with trucks.

Ability to Meet Needs

Safety

Safety would improve on the general purpose lanes due to wider shoulders.

Capacity

Traffic operating conditions for each toll scenario and with and without Rail Concept 3 are illustrated in Table 3.2-1 in the *I-81 Corridor Improvement Study Concept Development Technical Report*, which indicate that:

- In the car lanes, 43 to 141 miles (7 to 22 percent) would operate below the level of service standard
- In the general purpose lanes, 0 to 171 miles (0 to 26 percent) would operate below the level of service standard
- In the car lanes, 36 to 144 miles (6 to 22 percent) would provide more lanes than are needed
- In the general purpose lanes, 105 to 650 miles (16 to 100 percent) would provide more lanes than are needed

Cost

Separated Lane Concept 5 in combination with Rail Concept 3 and the addition of one or two non-separated lanes would cost approximately \$11.2 – \$13.0 billion in 2005 dollars and \$16.4 – \$19.0 billion in 2015 dollars.

3.2.11 Improvement Concepts Under Consideration

In 2035, at least 37 percent of I-81 needs one additional lane in each direction. Specifically, these sections are from:

- | | |
|------------------------------------|------------------------------------|
| ■ Exit 3 to Exit 5 northbound; | ■ Exit 86 to Exit 89 southbound; |
| ■ Exit 19 to Exit 81 northbound; | ■ Exit 96 to Exit 101 southbound; |
| ■ Exit 162 to Exit 168 northbound; | ■ Exit 105 to Exit 109 southbound; |

- Exit 243 to Exit 245 northbound;
- Exit 247 to Exit 251 northbound;
- Exit 257 to Exit 269 northbound;
- Exit 273 to Exit 279 northbound;
- Exit 310 to Exit 313 northbound;
- Exit 7 to Exit 10 southbound;
- Exit 17 to Exit 84 southbound;
- Exit 114 to Exit 118 southbound;
- Exit 156 to Exit 167 southbound;
- Exit 168 to Exit 191 southbound;
- Exit 243 to Exit 251 southbound;
- Exit 264 to Exit 277 southbound; and
- Exit 310 to Exit 313 southbound;

For these sections, the “Build” concepts under consideration are only those that provide for one additional lane in each direction.

Most of the remaining sections of I-81 need more than one lane in each direction in 2035.² Decisions on improvements to those sections (*e.g.*, the separation of cars from commercial vehicles) would be determined in Tier 2 when more site-specific information is available, if a “Build” concept (or portion of a “Build” concept) is advanced. In addition, the application of tolls or improvements to rail facilities would decrease the number of vehicles on I-81. Such a reduction would reduce the number of miles on I-81 that need more than one additional lane in each direction. Final decisions on the number of lanes to be constructed for sections that need more than one lane would be made at the conclusion of Tier 2, if a “Build” concept (or portion of a “Build” concept) is advanced.

3.3 U.S. Route 11

U.S. Route 11 is one of the main parallel travel routes to I-81, and the road most directly impacted by traffic congestion on I-81. It was therefore important to evaluate how traffic would change on U.S. Route 11 under three different basic conditions: 1) future growth by 2035 without any improvements on I-81 (No-Build), 2) traffic volume changes on U.S. Route 11 as a result of increased capacity on I-81, and 3) potential diversions onto U.S. Route 11 as a result of the implementation of a toll on I-81. The detailed findings of this evaluation are provided in the *Toll Impact Study* and the *Transportation Technical Report*.

Overall, the impact of I-81 improvements without tolls in almost all cases is a reduction in traffic on U.S. Route 11. In a few locations, this diversion away from U.S. Route 11 may be high enough to reduce 2035 traffic volumes close to existing traffic volumes. However, in most locations, the traffic reduction is more moderate in scale, with volumes higher than they are today, but fewer than can be expected if no improvements were made by 2035. If I-81 were widened, congested conditions still occur On U.S. Route 11 in the Harrisonburg and Winchester areas, but to a lesser extent.

² Two percent of the corridor, does not need any additional lanes in 2035.

With the low toll scenario, moderate volume increases occur on U.S. Route 11 only at two segments near the two ends of the study area, the first between Bristol and the Smyth/Wythe County line, and the second between Middletown (Exit 302) and Kernstown (Exit 310). However, given the shift of traffic to an improved I-81, it is anticipated that traffic volumes would still be below those projected for 2035 if no improvements were made.

With the high toll scenario, the greatest potential for volume increase is projected on U.S. Route 11 between Bristol and the Smyth/Wythe County line. Areas with moderate increases include between the Smyth/Wythe County line and Wytheville, between the Botetourt/Rockbridge County line and Lexington, between Maury (Exit 257) and Woodstock (Exit 283), and between Middletown (Exit 302) and Kernstown (Exit 310).

As shown in Table 4-16 in the *Transportation Technical Report*, by 2035, traffic volumes are expected to be double 2005 volume on a majority of U.S. Route 11 in Virginia. Roadway improvements will likely be necessary regardless of whether or not improvements are made to I-81. At no location on U.S. Route 11 are large volume increases anticipated as a result of toll diversion. In most locations, with an improved I-81, traffic volumes along U.S. Route 11 would be below 2035 No-Build projections. With regard to trucks (as presented in the *Toll Impact Study*), if all vehicles are tolled, an expanded I-81 would decrease truck traffic on local roadways to levels below what are projected under 2035 No-Build conditions.

3.4 Conclusions

The *I-81 Corridor Improvement Study* evaluated corridor-length concepts. These concepts were subjected to toll scenarios to illustrate the range of diversion and the impact of that diversion on what may need to be built. Conclusions reached from the concept development process include:

- The No-Build Concept does not satisfy the Purpose and Need.
- The TSM Concept, as a stand-alone concept, does not satisfy the Purpose and Need.
- The TSM Concept could compliment roadway improvements and can be used as an element of other concepts.
- No single consistent corridor-length concept satisfies the needs of I-81 in Virginia without providing more lanes than are needed.
- As stand-alone concepts, Rail improvements only slightly decrease the capacity needs on I-81 in 2035. As such, they do not satisfy the Purpose and Need and do not preclude the need for road improvements.
- Rail concepts can compliment roadway improvements through the construction of new intermodal terminals and/or through the construction of or improvement to access roads

to new or existing intermodal terminals, respectively, as well as through capacity improvements (*i.e.*, Rail Concept 3).

- The impacts on U.S. Route 11 and other roads (both local roads and other interstate facilities) from traffic that is diverted from I-81 as a result of tolls are low.
- Generally, the higher the toll, the more diversion of traffic from I-81 to other facilities, which reduces the number of required lanes on I-81. Also, trucks are less likely to divert from I-81 than passenger cars because a commercial trucker's value of time is higher than that of a passenger car. In other words, the additional time a trucker would need to travel on another may be more costly to the trucker than the toll itself.
- Nearly ½ of the traffic diverted from I-81 would be absorbed by U.S. Route 11. The remaining traffic diverted from I-81 is evenly distributed among other local roads, including other interstates (*i.e.* I-64 and I-95).
- Under the low toll scenario, traffic increases on the local road network, although in most locations traffic volumes would still be below 2035 No-Build conditions. Implementation of higher tolls on I-81 would result in a slight gain in traffic volumes as compared to the No-Build condition. However, the actual traffic impact on U.S. Route 11 and other roads resulting from the number of additional vehicles is low.
- The addition of one lane in each direction satisfies the Purpose and Need for approximately 39 to 64 percent of the corridor, depending upon the toll scenario.
- One separated truck lane in each direction does not satisfy the Purpose and Need in some sections, does not provide adequate opportunities for passing in all sections and provides limited opportunities to maneuver in the truck lane in the event of an emergency or evacuation.
- Two separated truck lanes in each direction provide more truck lanes than are needed for 266-650 miles of the corridor depending upon the toll scenario, the inclusion of Rail Concept 3 and the type of separation.
- No concept with two separated lanes in each direction, whether with or without a barrier or designated for truck or passenger vehicles, satisfies the Purpose and Need for the entire corridor without providing excess capacity.
- Non-exclusive separated lanes allow motorists in the separated lanes to weave across other lanes in order to use exit ramps and motorists using entrance ramps to weave across lanes to access the separated lanes. As traffic volume increases, weave segments become deficient in their ability to process demand safely and efficiently; leading to an increase in crash incidents. In addition, there are current national and local policies to eliminate weave sections on interstates. The creation of many weave and multi-merge sections is not supported by these policies and may not address the existing safety deficiencies along I-81. If a "Build" concept (or portion of a "Build" concept) is advanced to Tier 2, specific issues regarding weaving and how to appropriately and safely accommodate the maneuvers in a non-exclusive concept could be evaluated.

- Generally, the higher the toll, the more diversion of traffic from I-81 to other facilities, which slightly lowers the capacity improvement requirements on the I-81 mainline. With a low toll, nine miles of I-81 would need only one additional lane in each direction instead of two. With a high toll scenario, that number increases to 64 miles.
- When considering Rail 3 improvements in conjunction with a low toll, an additional 34 miles (43 total) of I-81 would need only one additional lane in each direction instead of two. With a high toll, an additional 29 miles (93 total) would need one additional lane in each direction instead of two.
- With the implementation of Rail Concept 3, the number of miles on I-81 that need two or more lanes would be reduced by 30 miles (out of a total of 650 miles) as a result of reduced demand on the interstate.
- Diversions due to tolls ranged from 2 to 25 percent of the total traffic depending upon the type and amount of the toll and the types of vehicles being diverted (total vehicles or just commercial vehicles).
- Based on the varying traffic demands, a concept with a variable number of lanes between interchanges of the corridor most efficiently addresses the needs of the roadway. The variable concepts would minimize the social, economic, and environmental impacts from consistent lane concepts and provide an opportunity to limit cost by not providing more lanes than are needed. Depending upon the toll scenario and whether or not Rail Concept 3 is used in combination, the number of miles where one lane is needed can be identified. For those miles where the provision of one additional lane does not meet the level of service standard, there are several potential multi-lane solutions.

A total of 239 miles of I-81 need one additional lane in each direction. Specifically, from:

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|------------------------------------|--|
| ■ Exit 3 to Exit 5 northbound; | ■ Exit 86 to Exit 89 southbound; |
| ■ Exit 19 to Exit 81 northbound; | ■ Exit 96 to Exit 101 southbound; |
| ■ Exit 162 to Exit 168 northbound; | ■ Exit 105 to Exit 109 southbound; |
| ■ Exit 243 to Exit 245 northbound; | ■ Exit 114 to Exit 118 southbound; |
| ■ Exit 247 to Exit 251 northbound; | ■ Exit 156 to Exit 167 southbound; |
| ■ Exit 257 to Exit 269 northbound; | ■ Exit 168 to Exit 191 southbound; |
| ■ Exit 273 to Exit 279 northbound; | ■ Exit 243 to Exit 251 southbound; |
| ■ Exit 310 to Exit 313 northbound; | ■ Exit 264 to Exit 277 southbound; and |
| ■ Exit 7 to Exit 10 southbound; | ■ Exit 310 to Exit 313 southbound. |
| ■ Exit 17 to Exit 84 southbound; | |

For these sections of I-81, the “Build” concepts under consideration are those that provide for one additional lane in each direction. However, certain sections of the corridor (particularly in



the central to northern part of the state) may require an additional lane in each direction to properly account for transitions between number of lanes and construction of auxiliary lanes.

All other sections of I-81 need more than one lane in each direction. For those sections, concepts that provide more than one lane in each direction are also still under consideration. Decisions on improvements in those sections (*e.g.*, the separation of cars from commercial vehicles) would be determined in Tier 2 when more site-specific information is available, if a “Build” concept (or a portion of a “Build” concept) is advanced. In addition, the application of tolls or improvements to rail facilities would decrease the number of vehicles on I-81 and, therefore, may increase the number of miles on I-81 that need one additional lane in each direction (instead of two additional lanes). Final decisions on the number of lanes to be constructed would be made at the conclusion of Tier 2, if a “Build” concept (or portion of a “Build” concept) is advanced.



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